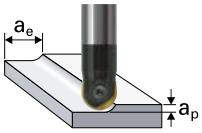
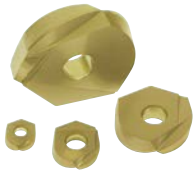
# Indexable Milling Tools

## ABPF/M | Recommended Cutting Conditions



| Work piece material | | Recommend grade & Target hardness (HRC) 30 | 40 | 50 | Emulsion | Mist | Air | Parameter | | D 8 Semi Finishing General | D 8 Semi Finishing High Feed | D 8 Finishing | D 10 Semi Finishing General | D 10 Semi Finishing High Feed | D 10 Finishing | D 12 Semi Finishing General | D 12 Semi Finishing High Feed | D 12 Finishing |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I II | Carbon-Steel Alloy-Steel <30HRC | PCA12M | | | • | • | • | $V_c$ | m/min | 200 | 300 | 400 | 200 | 300 | 400 | 200 | 300 | 400 |
| | | ATH10E | | | • | • | • | n | $min^{-1}$ | 7960 | 11940 | 15920 | 6370 | 9550 | 12730 | 5310 | 7960 | 10610 |
| | | | | | | | | $f_z$ | mm/t | 0.2 | 0.4 | 0.1 | 0.2 | 0.4 | 0.12 | 0.2 | 0.4 | 0.15 |
| | | | | | | | | $V_f$ | mm/min | 3180 | 9550 | 3180 | 2550 | 7640 | 3060 | 2120 | 6370 | 3180 |
| | | ACS05E | | | • | • | • | $a_p$ | mm | 0.2 | 0.1 | 0.2 | 0.5 | 0.2 | 0.2 | 0.6 | 0.3 | 0.2 |
| | | | | | | | | $a_e$ | mm | 0.5 | 0.5 | 0.1 | 1 | 1 | 0.12 | 1.2 | 1.2 | 0.15 |
| III | Alloy-Steel Tool-Steel 30~40HRC | PCA12M | | | • | • | • | $V_c$ | m/min | 180 | 250 | 350 | 180 | 250 | 350 | 180 | 250 | 350 |
| | | | | | | | | n | $min^{-1}$ | 7160 | 9950 | 13930 | 5730 | 7960 | 11140 | 4770 | 6630 | 9280 |
| | | PCA08M | | | • | • | • | $f_z$ | mm/t | 0.15 | 0.25 | 0.1 | 0.15 | 0.25 | 0.12 | 0.15 | 0.25 | 0.15 |
| | | PTH08M | | | • | • | • | $V_f$ | mm/min | 2150 | 4970 | 2790 | 1720 | 3980 | 2670 | 1430 | 3320 | 2790 |
| | | ACS05E | | | • | • | • | $a_p$ | mm | 0.2 | 0.1 | 0.2 | 0.5 | 0.2 | 0.2 | 0.6 | 0.3 | 0.2 |
| | | | | | | | | $a_e$ | mm | 0.5 | 0.5 | 0.1 | 1 | 1 | 0.12 | 1.2 | 1.2 | 0.15 |
| IV | Pre-Hardened Steel Tool-Steel 40~50HRC | | | | | | | $V_c$ | m/min | 120 | 200 | 300 | 120 | 200 | 300 | 120 | 200 | 300 |
| | | | | | | | | n | $min^{-1}$ | 4770 | 7960 | 11940 | 3820 | 6370 | 9550 | 3180 | 5310 | 7960 |
| | | PCA08M | | | • | • | • | $f_z$ | mm/t | 0.1 | 0.15 | 0.1 | 0.1 | 0.15 | 0.12 | 0.1 | 0.15 | 0.15 |
| | | PTH08M | | | • | • | • | $V_f$ | mm/min | 950 | 2390 | 2390 | 760 | 1910 | 2290 | 640 | 1590 | 2390 |
| | | | | | | | | $a_p$ | mm | 0.2 | 0.1 | 0.1 | 0.4 | 0.2 | 0.1 | 0.5 | 0.3 | 0.1 |
| | | | | ATH80D | • | • | • | $a_e$ | mm | 0.5 | 0.5 | 0.1 | 1 | 1 | 0.12 | 1.2 | 1.2 | 0.15 |
| V | Hardened Steel Tool-Steel 50~55HRC | | | | | | | $V_c$ | m/min | 100 | 150 | 250 | 100 | 150 | 250 | 100 | 150 | 250 |
| | | | | | | | | n | $min^{-1}$ | 3980 | 5970 | 9950 | 3180 | 4770 | 7960 | 2650 | 3980 | 6630 |
| | | PCA08M | | | • | • | • | $f_z$ | mm/t | 0.1 | 0.15 | 0.1 | 0.1 | 0.15 | 0.12 | 0.1 | 0.15 | 0.15 |
| | | PTH08M | | | • | • | • | $V_f$ | mm/min | 800 | 1790 | 1990 | 640 | 1430 | 1910 | 530 | 1190 | 1990 |
| | | | | | | | | $a_p$ | mm | 0.2 | 0.1 | 0.1 | 0.3 | 0.2 | 0.1 | 0.4 | 0.2 | 0.1 |
| | | | | ATH80D | • | • | • | $a_e$ | mm | 0.5 | 0.5 | 0.1 | 1 | 1 | 0.12 | 1.2 | 1.2 | 0.15 |
| V | Hardened Steel > 55HRC | | | | | | | $V_c$ | m/min | 80 | 120 | 200 | 80 | 120 | 200 | 80 | 120 | 200 |
| | | | | | | | | n | $min^{-1}$ | 3180 | 4770 | 7960 | 2550 | 3820 | 6370 | 2120 | 3180 | 5310 |
| | | PCA08M | | | • | • | • | $f_z$ | mm/t | 0.1 | 0.15 | 0.1 | 0.1 | 0.15 | 0.12 | 0.1 | 0.15 | 0.15 |
| | | PTH08M | | | • | • | • | $V_f$ | mm/min | 640 | 1430 | 1590 | 510 | 1150 | 1530 | 420 | 950 | 1590 |
| | | | | | | | | $a_p$ | mm | 0.2 | 0.1 | 0.1 | 0.3 | 0.2 | 0.1 | 0.4 | 0.2 | 0.1 |
| | | | | ATH80D | • | • | • | $a_e$ | mm | 0.5 | 0.5 | 0.1 | 1 | 1 | 0.12 | 1.2 | 1.2 | 0.15 |
| VIII | Cast-Iron GG EN-JL10** EN-GJL-*** | PCA12M | | | • | • | • | $V_c$ | m/min | 200 | 300 | 400 | 200 | 300 | 400 | 200 | 300 | 400 |
| | | ATH10E | | | • | • | • | n | $min^{-1}$ | 7960 | 11940 | 15920 | 6370 | 9550 | 12730 | 5310 | 7960 | 10610 |
| | | | | | | | | $f_z$ | mm/t | 0.15 | 0.2 | 0.1 | 0.15 | 0.2 | 0.12 | 0.15 | 0.2 | 0.15 |
| | | | | | | | | $V_f$ | mm/min | 2390 | 4770 | 3180 | 1910 | 3820 | 3060 | 1590 | 3180 | 3180 |
| | | ACS05E | | | • | • | • | $a_p$ | mm | 0.2 | 0.1 | 0.2 | 0.5 | 0.2 | 0.2 | 0.6 | 0.3 | 0.2 |
| | | | | | | | | $a_e$ | mm | 0.5 | 0.5 | 0.1 | 1 | 1 | 0.12 | 1.2 | 1.2 | 0.15 |
| VIII | Cast-Iron GGG EN-JS10** EN-GJS-*** | PCA12M | | | • | • | • | $V_c$ | m/min | 120 | 200 | 300 | 120 | 200 | 300 | 120 | 200 | 300 |
| | | ATH10E | | | • | • | • | n | $min^{-1}$ | 4770 | 7960 | 11940 | 3820 | 6370 | 9550 | 3180 | 5310 | 7960 |
| | | | | | | | | $f_z$ | mm/t | 0.1 | 0.15 | 0.1 | 0.1 | 0.15 | 0.12 | 0.1 | 0.15 | 0.15 |
| | | | | | | | | $V_f$ | mm/min | 950 | 2390 | 2390 | 760 | 1910 | 2290 | 640 | 1590 | 2390 |
| | | ACS05E | | | • | • | • | $a_p$ | mm | 0.2 | 0.1 | 0.2 | 0.5 | 0.2 | 0.2 | 0.6 | 0.3 | 0.2 |
| | | | | | | | | $a_e$ | mm | 0.5 | 0.5 | 0.1 | 1 | 1 | 0.12 | 1.2 | 1.2 | 0.15 |
| VI | Stainless Steels High alloy Steels | PCA12M | | | • | • | • | $V_c$ | m/min | 120 | 200 | 300 | 120 | 200 | 300 | 120 | 200 | 300 |
| | | | | | | | | n | $min^{-1}$ | 4770 | 7960 | 11940 | 3820 | 6370 | 9550 | 3180 | 5310 | 7960 |
| | | PCA08M | | | • | • | • | $f_z$ | mm/t | 0.15 | 0.25 | 0.1 | 0.15 | 0.25 | 0.12 | 0.15 | 0.25 | 0.15 |
| | | PTH08M | | | • | • | • | $V_f$ | mm/min | 1430 | 3980 | 2390 | 1150 | 3180 | 2290 | 950 | 2650 | 2390 |
| | | ACS05E | | | • | • | • | $a_p$ | mm | 0.2 | 0.1 | 0.2 | 0.5 | 0.2 | 0.2 | 0.6 | 0.3 | 0.2 |
| | | | | | | | | $a_e$ | mm | 0.5 | 0.5 | 0.1 | 1 | 1 | 0.12 | 1.2 | 1.2 | 0.15 |

# Indexable Milling Tools

| D 16 | | | D 20 | | | D 25 | | | D 32 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Semi Finishing | | | Semi Finishing | | | Semi Finishing | | | Semi Finishing | | |
| General | High Feed | Finishing | General | High Feed | Finishing | General | High Feed | Finishing | General | High Feed | Finishing |
| 200 | 300 | 400 | 200 | 300 | 400 | 200 | 300 | 400 | 200 | 300 | 400 |
| 3980 | 5970 | 7960 | 3180 | 4770 | 6370 | 2550 | 3820 | 5090 | 1990 | 2980 | 3980 |
| 0.2 | 0.4 | 0.2 | 0.2 | 0.4 | 0.25 | 0.2 | 0.4 | 0.3 | 0.2 | 0.4 | 0.4 |
| 1590 | 4770 | 3180 | 1270 | 3820 | 3180 | 1020 | 3060 | 3060 | 800 | 2390 | 3180 |
| 0.8 | 0.4 | 0.2 | 1 | 0.6 | 0.2 | 1.2 | 0.8 | 0.2 | 1.5 | 1 | 0.2 |
| 1.5 | 1.5 | 0.2 | 2 | 2 | 0.25 | 2.5 | 2.5 | 0.3 | 3 | 3 | 0.4 |
| 180 | 250 | 350 | 180 | 250 | 350 | 180 | 250 | 350 | 180 | 250 | 350 |
| 3580 | 4970 | 6960 | 2860 | 3980 | 5570 | 2290 | 3180 | 4460 | 1790 | 2490 | 3480 |
| 0.15 | 0.25 | 0.2 | 0.15 | 0.25 | 0.25 | 0.15 | 0.25 | 0.3 | 0.15 | 0.25 | 0.4 |
| 1070 | 2490 | 2790 | 860 | 1990 | 2790 | 690 | 1590 | 2670 | 540 | 1240 | 2790 |
| 0.8 | 0.4 | 0.2 | 1 | 0.6 | 0.2 | 1.2 | 0.8 | 0.2 | 1.5 | 1 | 0.2 |
| 1.5 | 1.5 | 0.2 | 2 | 2 | 0.25 | 2.5 | 2.5 | 0.3 | 3 | 3 | 0.4 |
| 120 | 200 | 300 | 120 | 200 | 300 | 120 | 200 | 300 | 120 | 200 | 300 |
| 2390 | 3980 | 5970 | 1910 | 3180 | 4770 | 1530 | 2550 | 3820 | 1190 | 1990 | 2980 |
| 0.1 | 0.15 | 0.2 | 0.1 | 0.15 | 0.25 | 0.1 | 0.15 | 0.3 | 0.1 | 0.15 | 0.4 |
| 480 | 1190 | 2390 | 380 | 950 | 2390 | 310 | 760 | 2290 | 240 | 600 | 2390 |
| 0.6 | 0.4 | 0.1 | 0.8 | 0.5 | 0.1 | 1 | 0.6 | 0.1 | 1.2 | 0.8 | 0.1 |
| 1.5 | 1.5 | 0.2 | 2 | 2 | 0.25 | 2.5 | 2.5 | 0.3 | 3 | 3 | 0.4 |
| 100 | 150 | 250 | 100 | 150 | 250 | 100 | 150 | 250 | 100 | 150 | 250 |
| 1990 | 2980 | 4970 | 1590 | 2390 | 3980 | 1270 | 1910 | 3180 | 990 | 1490 | 2490 |
| 0.1 | 0.15 | 0.2 | 0.1 | 0.15 | 0.25 | 0.1 | 0.15 | 0.3 | 0.1 | 0.15 | 0.4 |
| 400 | 900 | 1990 | 320 | 720 | 1990 | 250 | 570 | 1910 | 200 | 450 | 1990 |
| 0.5 | 0.3 | 0.1 | 0.6 | 0.4 | 0.1 | 0.8 | 0.5 | 0.1 | 1 | 0.7 | 0.1 |
| 1.5 | 1.5 | 0.2 | 2 | 2 | 0.25 | 2.5 | 2.5 | 0.3 | 3 | 3 | 0.4 |
| 80 | 120 | 200 | 80 | 120 | 200 | 80 | 120 | 200 | 80 | 120 | 200 |
| 1590 | 2390 | 3980 | 1270 | 1910 | 3180 | 1020 | 1530 | 2550 | 800 | 1190 | 1990 |
| 0.1 | 0.15 | 0.2 | 0.1 | 0.15 | 0.25 | 0.1 | 0.15 | 0.3 | 0.1 | 0.15 | 0.4 |
| 320 | 720 | 1590 | 250 | 570 | 1590 | 200 | 460 | 1530 | 160 | 360 | 1590 |
| 0.5 | 0.3 | 0.1 | 0.6 | 0.4 | 0.1 | 0.8 | 0.5 | 0.1 | 1 | 0.7 | 0.1 |
| 1.5 | 1.5 | 0.2 | 2 | 2 | 0.25 | 2.5 | 2.5 | 0.3 | 3 | 3 | 0.4 |
| 200 | 300 | 400 | 200 | 300 | 400 | 200 | 300 | 400 | 200 | 300 | 400 |
| 3980 | 5970 | 7960 | 3180 | 4770 | 6370 | 2550 | 3820 | 5090 | 1990 | 2980 | 3980 |
| 0.15 | 0.2 | 0.2 | 0.15 | 0.2 | 0.25 | 0.15 | 0.2 | 0.3 | 0.15 | 0.2 | 0.4 |
| 1190 | 2390 | 3180 | 950 | 1910 | 3180 | 760 | 1530 | 3060 | 600 | 1190 | 3180 |
| 0.8 | 0.4 | 0.2 | 1 | 0.6 | 0.2 | 1.2 | 0.8 | 0.2 | 1.5 | 1 | 0.2 |
| 1.5 | 1.5 | 0.2 | 2 | 2 | 0.25 | 2.5 | 2.5 | 0.3 | 3 | 3 | 0.4 |
| 120 | 200 | 300 | 120 | 200 | 300 | 120 | 200 | 300 | 120 | 200 | 300 |
| 2390 | 3980 | 5970 | 1910 | 3180 | 4770 | 1530 | 2550 | 3820 | 1190 | 1990 | 2980 |
| 0.1 | 0.15 | 0.2 | 0.1 | 0.15 | 0.25 | 0.1 | 0.15 | 0.3 | 0.1 | 0.15 | 0.4 |
| 480 | 1190 | 2390 | 380 | 950 | 2390 | 310 | 760 | 2290 | 240 | 600 | 2390 |
| 0.8 | 0.4 | 0.2 | 1 | 0.6 | 0.2 | 1.2 | 0.8 | 0.2 | 1.5 | 1 | 0.2 |
| 1.5 | 1.5 | 0.2 | 2 | 2 | 0.25 | 2.5 | 2.5 | 0.3 | 3 | 3 | 0.4 |
| 120 | 200 | 300 | 120 | 200 | 300 | 120 | 200 | 300 | 120 | 200 | 300 |
| 2390 | 3980 | 5970 | 1910 | 3180 | 4770 | 1530 | 2550 | 3820 | 1190 | 1990 | 2980 |
| 0.15 | 0.25 | 0.2 | 0.15 | 0.25 | 0.25 | 0.15 | 0.25 | 0.3 | 0.15 | 0.25 | 0.4 |
| 720 | 1990 | 2390 | 570 | 1590 | 2390 | 460 | 1270 | 2290 | 360 | 990 | 2390 |
| 0.8 | 0.4 | 0.2 | 1 | 0.6 | 0.2 | 1.2 | 0.8 | 0.2 | 1.5 | 1 | 0.2 |
| 1.5 | 1.5 | 0.2 | 2 | 2 | 0.25 | 2.5 | 2.5 | 0.3 | 3 | 3 | 0.4 |

| Cutting Conditions | | Page | | Page |
|---|---|---|---|---|
| ARPF D8 – 32 | Semi Finishing | 14–15 | Finishing | 14–15 |

Advanced Engineering

# ABPF/M / ARPF/M | Cutting Conditions | Long up to 10x Dia

## Long condition are based on short condition data-sheet, please adopt like follow:

**Option I: Higher feed ($V_f$) in combination with lower depth ($a_p$)**

| OH | $V_c$ | $V_f$ | $a_p$ |
|---|---|---|---|
| till 3x Dia | 100% | 100% | 100% |
| ~ 5x Dia | 100% | 100% | 80% |
| ~ 8x Dia | 90% | 90% | 50% |
| ~ 10x Dia | 80% | 80% | 25% |

The most important factor is to reduced drastically $a_p$ and not $V_c$ or $V_f$
The main factor for flections is the contact and not the movement

**Info: double over-hang length = 8 times increased flections!**

**Option II: Depth ($a_p$) kept in combination with reduced speed ($V_c$) and feed ($V_f$)**

| OH | $V_c$ | $V_f$ | $a_p$ |
|---|---|---|---|
| till 3x Dia | 100% | 100% | 100% |
| ~ 5x Dia | 70% | 70% | 100% |
| ~ 8x Dia | 60% | 60% | 100% |
| ~ 10x Dia | 50% | 50% | 100% |

The most important is to reduced the force in case of bigger depth ($a_p$)
In case of bigger Dia (20~32) the flections and cutting-force is less

**Info: double tool Dia = 16 times reduced flections!**

## General-Info

**These are recommended conditions which has to be adopted to material-machine-strategy Conditions**

- If no problems in long using, speeds - feeds - depth can be improved like short conditions
- If wear problems occurs, $V_c$ should be reduced or feed per tooth ($f_z$) should be increased
- If chipping problems occurs, OH or depth ($a_p$) should be reduced

**Insert & screw**

- Insert should be replaced if wear or chipping occurs in order not to damage the body
- Before fixing new insert, body-seat - screw and new insert has to be cleaned
- Screw for insert should be tightened not to strong - paste should be used
- Screw should be replaced when damaged or difficult for tightening - to keep tolerance

**Surface-quality**

- Surface roughness should be decide from cusp-height formula or by $f_z$ concept
- Air-blow will help to evacuate chip's from the cutting zone in order not to have re-cuttings
- Air or high-pressure emulsion can help to reach better optical surface
- Down-cutting (climb milling) and may 45° machining is recommended

# ARPF/M | ARPF - 3D Chart

**$f_z - a_p - z_e$ list for 3D milling**

| Job field | Surface roughness | | | Corner-R size (mm) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Drawing | Ra (µm) | Rz (µm) | 0.3 | 0.5 | 1.0 | 1.5 | 2.0 | 3.0 |
| Punching mold \| Die-casting mold \| Plastic mold | ▽▽▽▽ Super Finishing | 0.05 | 0.4 | 0.01 | 0.01 | 0.02 | 0.02 | 0.03 | 0.03 |
| | | 0.1 | 0.8 | 0.02 | 0.02 | 0.03 | 0.03 | 0.04 | 0.05 |
| Plastic mold \| Die-casting mold \| Forging mold | ▽▽▽ Finishing | 0.4 | 1.6 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 |
| | | 1.6 | 6.3 | 0.04 | 0.06 | 0.08 | 0.10 | 0.11 | 0.14 |
| Forging mold Press mold | ▽▽ Semi Finishing | 3.2 | 12.56 | 0.06 | 0.08 | 0.11 | 0.14 | 0.16 | 0.19 |
| | | 6.3 | 25 | 0.09 | 0.11 | 0.16 | 0.19 | 0.22 | 0.27 |
| Press mold | ▽ Roughing | 12.5 | 50 | 0.12 | 0.16 | 0.22 | 0.27 | 0.32 | 0.39 |
| | | 25 | 100 | 0.15 | 0.22 | 0.32 | 0.39 | 0.45 | 0.55 |

**For 3D cutting, we recommend to increase $V_c$ 20% more, and use following $f_z/a_p/a_e$.**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HTT615 1503-AxPF-M-6.5 BW-DS